

Chapter 5

Hydrology and Water Quality

Setting

Watershed and Lagoon Setting

Malibu Lagoon is located at the southern extent (or mouth) of the Malibu Creek watershed (Figure 5-1). The Malibu Creek watershed covers approximately 110 square miles, is the second largest watershed draining into Santa Monica Bay, and the largest draining from the Santa Monica Mountains.

As described below, the hydrology and physical processes influencing the lagoon are complex and involve several sources. The Malibu Creek watershed contributes streamflow, groundwater, sediment, nutrients, and other water constituents downstream to the lagoon. As such, any assessment of lagoon management or restoration activities should include consideration of the hydrologic contributions to the lagoon from the upstream watershed as well as discharges from the lagoon to the immediate coastal environment.

The Malibu Creek watershed can be divided into two general sub-basin areas. The upper watershed is considered as the area upstream of the Cold Creek stream confluence and Malibu Canyon. The northwestern portion of the upper watershed (north of Hwy 101) includes several north-south oriented tributary streams such as Las Virgenes Creek, Chesebro Canyon, Palo Comado Canyon, Medea Creek, and Lindero Canyon. Farther to the east, the headwaters of the main arm of Malibu Creek extend and drain the north slope of the Santa Monica Mountains. Hydrologically, these headwater tributaries are important to the overall Malibu Creek system, and do affect the flows that reach the lagoon downstream.

Vegetation in the upper watershed headwater areas typically consists of (or once consisted of) oak-grassland type landscapes in the northern tributary areas and more of a chaparral/oak woodland landscape along the north slope of the Santa Monica Mountains. The vegetative cover has several important hydrologic influences on the creek system, including rainfall interception and infiltration. Perhaps most importantly though is the fire regime that periodically burns the grassland/chaparral hillslopes.

Figure 5-1. Malibu Creek Watershed



Figure 5-1
Malibu Creek Watershed Boundary

When this occurs, erosion and runoff potential greatly increases as was recently observed in the Malibu Creek and Big Sycamore Canyon watersheds following the fires of November 1993 (Schwarz 1995). Such post-fire erosion conditions can deliver large amounts of sediment to the Lagoon in brief episodic events.

Soils in the upper watershed are variably sandy, silty, clayey, or loams depending upon the source geology. The northern watershed areas are generally underlain with sandstone and shale Tertiary (Miocene) sedimentary rocks of the Upper Topanga and Monterey Formations. Variable grazing activity has occurred there since the 19th century.

In the last 50 years, and particularly the last 25 years, many of these northern headwater areas have been developed as residential neighborhoods. This has increased the degree of impervious surface in the upper watershed, which has increased stormflow discharges downstream into the lagoon. Other hydrologic changes in the upper watershed include increased dry season flows (mostly from irrigation used from imported water sources). These increased dry season flows have resulted in generally higher streamflow input into the lagoon during the summer months.

The Las Virgenes Municipal Water District and Triunfo Sanitation District operate the Tapia Water Reclamation Facility, located just upstream of Malibu Lagoon (near the intersection of Malibu Canyon Rd. and Piuma Rd.). This plant handles about 9 million gallons of wastewater daily for 85,000 residents of western Los Angeles and eastern Ventura counties (see <http://www.lvmwd.dst.ca.us/index.html>). Water is treated to a “tertiary” level that is certified safe for irrigation and some indoor uses such as flushing, etc. Under permit requirements by the Los Angeles RWQCB, the Tapia plant cannot discharge into Malibu Creek between April 15 and November 15 each year.

The lower watershed includes the steep and rugged Malibu Canyon, which cuts through the central axis (strike) of the Santa Monica Mountains. Downstream of Malibu Canyon, the watershed emerges onto a coastal plain where channel slopes and flow velocities reduce and the Malibu Creek fluvial system begins to transition to a coastal estuarine lagoon system.

Historically, the Malibu estuarine-lagoon system was typically larger (in expanse) than its current relatively narrow position at the eastern extent of the Malibu plain area. This is seen through historic aerial photos since the 1920s (Ambrose and Orme 2000) as well as the record of stream and lagoonal sediments that are found in the Malibu plain area indicating the lagoon had a larger spatial range. Similar to today, the historic size of the lagoon would have been influenced by governing physical processes and would have ranged in size from small to large depending on influencing hydrologic conditions.

Hydrologic Processes

Seasonal Lagoon and Hydrologic Inputs/Outputs

As a transitional river-mouth type estuarine lagoon, the hydro-geomorphology of the lagoon can be generally described according to a two-season system, under either wetter winter conditions or drier summer conditions. More precisely, the lagoon form reflects the relative balance of three governing forces: streamflow, tides, and waves.

In the wetter winter months when streamflows in Malibu Creek are greater, moderate runoff and flows can maintain an open outlet channel to the coast. When winter runoff is punctuated by particularly large flow events, such flows can open the river-mouth by removing a portion or the entire barrier beach. This was observed in the winter of 1997–98 (Schwarz 1999) and to a lesser degree in other recent strong winter flow events.

In the days/weeks following winter storms, or between storms, streamflow hydrographs recede into lower baseflow conditions. The hydrologic result of such “lulls” is that waves and tides are able to enter the lagoon and circulate more saline ocean water back into the lagoon and its side channels. During drier winter seasons or extended years of relative aridity, such a broad lagoon opening may not occur at all.

Towards the spring months and into the drier summer months, the relative force of streamflow decreases in comparison to coastal processes (waves, tides). As a result, beach sands are deposited onto the barrier beach and ebb/flood tidal sand deltas; the barrier beach crest heightens and moves inland; and the tidal inlet channel may narrow, migrate eastward with the longshore current, and potentially close. As a result of these processes, the dry season lagoon typically experiences increasingly less circulation of coastal water. If the barrier beach entirely seals itself, pinching off the tidal inlet channel, a closed lagoon situation occurs with essentially static water behind the barrier beach.

Due to increases in dry season runoff in the Malibu Creek watershed (as well as immediately local sources in the Malibu plain area), water surface elevations in a closed lagoon condition can raise lagoon water levels to nearly overtop the barrier beach crest, and may cause local septic/sewer back up in the immediate lagoon area. When this occurs, summer breaching of the closed lagoon has occurred through various means, including:

- mechanical breaching by equipment under local DPR authority and supervision;
- informal breaching by local beach goers who can successfully breach the barrier through starting a small initial channel; or

- breaching by natural processes such as strong waves hitting the closed barrier during a falling high tide when head difference between the closed lagoon and coast are greatest.

It is important to note that specific lagoon conditions in any given year reflect the overall balance of these governing forces described above (streamflow, waves, tides, local inflow from immediate lagoon surroundings, breaching activities, etc.). Lagoon hydrology and geomorphic form can thus be considered as a range between two endpoints: the fully open estuary with no barrier beach and a fully closed lagoon with no tidal inlet channel. Most often, the lagoon operates in the mid-range of such a two-season spectrum, functioning with some degree of streamflow, some degree of tidal exchange with the coast, and some degree of internal circulation.

Flooding

Flooding adjacent to the lagoon can potentially occur due to the same general governing forces described above. In the winter season, high stormflows can raise lagoon water levels to inundate surrounding areas, though typically, under very large events, the removal of a portion (or all) of the barrier beach will enable stormflows to reach (and exit at) the coast.

The timing of stormflows arriving from the creek to the coast in relation to the tide is a potentially important factor in local flooding. Stormflows reaching the lagoon during very high tides are held up (or “back-watered”) and this process can cause local flooding in the immediate lagoon surroundings. Other potential threats from flooding can occur upstream, north of the relatively new Pacific Coast Hwy bridge (re-built in the mid/late 1990s) where high stormflows on Malibu Creek have caused some local bank erosion, along the west bank near Cross Creek Shopping Center as well as on the more vegetated east bank.

As seen in historical aerial photos (such as following the large floods of March 1938), past large river flows inundated much of the current Malibu plain area. Future large flows could potentially overtop the banks of Malibu Creek upstream of the lagoon, or create a channel avulsion (cutting of new channel path) and potentially flood areas west or east of the current river/lagoon alignment.

Groundwater and Water Balance

An estimated water budget for the lagoon under closed summer conditions was provided by Stone Environmental (2004). In this accounting, 92% of the Lagoon inflow came from stream sources and 8% came from groundwater sources. In terms of outflow, 2% was evaporated while 98% was lost through beach percolation.

Water Quality

Watershed Inputs

Water quality within the lagoon is influenced by land uses both upstream and adjacent to the lagoon, including surface water runoff, discharges from Tapia Wastewater Treatment Plant, and seepage from septic systems. Additionally, because the lagoon is tidal, oceanic waters also influence water quality within the lagoon. Primary water quality constituents of concern to beneficial uses of the lagoon are sediment, nutrients, and bacteria.

Sediment

Depending upon winter storm events and flow conditions, much of the sediment that is transported from the watershed is deposited into the main body of the lagoon. If stormflows are large enough and a sizable breach in the barrier beach occurs, the sediment may be transported directly to the coastal zone. Of the sediment that is not carried into the coastal zone, much of the finer sediments are redistributed into the quieter settling areas of the three western channels.

Bed elevation monitoring has shown that the lagoon bed has accreted since the late 1990s (Moffatt & Nichol 2005). This accretion has reduced the storage volume of the lagoon by 10.6 acre-feet between 1998 and 2004 and has caused the bed to become perched above mean sea level (Moffatt & Nichol 2005). This condition interferes with tidal actions and stormflows, which would normally flush fine-grained sediments out to sea, particularly when the lagoon mouth is open.

Sedimentation is particularly evident in the western arms of the lagoon, where nitrogen and phosphorus concentrations increase within the fine-grained particles, contributing to formation of eutrophic conditions in the lagoon. Additionally, the aggraded condition of the west portion of the lagoon results in a shallower water column that in turn increases water temperature.

Nutrients

Malibu Lagoon is included on the federal 303(d) list of impaired water bodies due to excessive nutrients from surrounding land uses, which causes eutrophication and subsequent impairment of beneficial uses. According to Sutula et al. and Ambrose and Orme, the sources of nitrogen to the lagoon are:

- septic systems, upland systems, and surface runoff (77%);
- sediment release (17%); and
- other sources (6%).

Sources of phosphorus to the lagoon are:

- septic systems, upland systems, and surface runoff (95%); and
- sediment release (5%)

Seasonal changes in circulation and sedimentation affect the concentration of nitrogen and phosphorus in the lagoon. For example, nitrogen and phosphorus loading and concentrations in the winter are double that in the summer (Moffatt & Nichol 2005). Increased water temperatures and light availability during summer months promote an exponential increase in photosynthetic rates within the lagoon.

During the summer months, when the mouth of the lagoon typically closes, water quality in the lagoon worsens due to reduced circulation, warmer temperatures, and reduced dilution in the more stagnant closed lagoon setting. Stored nitrogen and phosphorus from the winter, combined with these summer conditions, results in nuisance algal blooms, low dissolved oxygen levels, odors, and fish kills; ultimately resulting in impairment of beneficial uses.

Bacteria

The lagoon is included on the federal 303(d) list of impaired water bodies due to excessive coliform bacteria, which affects recreational beneficial uses. The bacteria TMDL for the Malibu Creek Watershed estimates that 158,000 billion counts of fecal coliform are annually present in the lagoon, which are transported from surrounding sources including wastewater treatment discharge and septic systems. By reducing the fecal coliform concentrations in septic systems and leach fields, an 86% loading reduction to 21,800 billion counts per year in the lagoon can be achieved (USEPA 2003b).

Regulatory Setting

The following sections briefly describe federal and state water quality control programs, plans, and policies that are applicable to the project site and environs.

Clean Water Act

There are several sections of the federal Clean Water Act (CWA) that pertain to regulating impacts on waters of the United States. Section 101 specifies the objectives of CWA implemented largely through Title III (Standards and Enforcement) and Section 301 (Prohibitions). The discharge of dredged or fill material into waters of the United States is subject to permitting specified under Title IV (Permits and Licenses) of CWA and specifically under Section 404 of

the act (Discharges of Dredge or Fill Material). Section 401 (Certification) specifies additional requirements for permit review, particularly at the state level.

Section 303—TMDL Program

The State of California adopts water quality standards to protect beneficial uses of state waters as required by Section 303 of the CWA and the state's Porter–Cologne Water Quality Control Act of 1969. Section 303(d) of CWA established the total maximum daily load (TMDL) process to guide the application of state water quality standards (see discussion of state water quality standards below).

To identify candidate water bodies for TMDL analysis, a list of water quality-limited segments is generated. These segments are impaired by the presence of pollutants, including sediment, and have no additional assimilative capacity for these pollutants. Malibu Beach, Malibu Creek, and Malibu Lagoon are listed as impaired water bodies under Section 303(d) of CWA. Malibu Lagoon is listed as impaired by enteric viruses, eutrophication, high coliform counts, pH, and also includes a shellfish harvesting advisory and swimming restrictions. Malibu Beach is listed as impaired by DDT and PCBs (fish consumption advisories), high coliform counts, and beach closures; Malibu Creek is listed as impaired by high coliform counts, nutrients (algae), scum/unnatural foam, and is also a fish barrier.

TMDLs to address nutrients and bacteria impairment within the Malibu Creek watershed, including the lagoon, were adopted in 2003 (EPA 2003a and b respectively). TMDLs to address other impairments in the watershed and surrounding beaches are currently under development.

TMDL for Nutrients in the Malibu Creek Watershed

The numeric targets established in US EPA (2003a) consider seasonal variations in nutrient concentrations, as well as waterbody types. The numeric targets for nitrogen and phosphorus in the Malibu Creek watershed, shown below, were established to prevent and reduce the nutrient impairment.

| Summer (April 15 to November 15) | | Winter (November 16 to April 14) |
|-------------------------------------|----------------------------|-------------------------------------|
| Total Nitrogen (mg/L) | Total Phosphorus (mg/L) | Total Nitrogen (mg/L) |
| 1.0 | 0.1 | 8.0 |

TMDL for Bacteria in the Malibu Creek Watershed

Bacteriological numeric targets to protect water contact recreational use in the lagoon, as established in US EPA (2003b), are as follows:

| Parameter | Geometric Mean | Single Sample |
|---------------------|----------------|--------------------------------------|
| Total | 1,000 | 10,000 or 1,000 <i>if</i> FC/TC >1.0 |
| Fecal | 200 | 400 |
| <i>Enterococcus</i> | 35 | 104 |

Section 401—Water Quality Certification

Section 401 of CWA requires that an applicant pursuing a federal permit to conduct any activity that may result in a discharge of a pollutant obtain a Water Quality Certification (or waiver). Water Quality Certifications are issued by Regional Water Quality Control Boards in California. The Los Angeles RWQCB has jurisdiction over the project area. Under the CWA, the state (as implemented by the relevant board) must issue or waive Section 401 Water Quality Certification for the project to be permitted under Section 404.

Water Quality Certification requires the evaluation of water quality considerations associated with dredging or placement of fill materials into waters of the United States. Construction of the proposed project would require 401 certification for the project if Section 404 is triggered.

Section 402—NPDES Program

The 1972 amendments to the Federal Water Pollution Control Act established the National Pollutant Discharge Elimination System (NPDES) permit program to control discharges of pollutants from point sources (Section 402). The 1987 amendments to the CWA created a new section of the CWA devoted to stormwater permitting (Section 402[p]).

The U.S. Environmental Protection Agency (EPA) has granted the State of California primacy in administering and enforcing the provisions of the CWA and the NPDES Permit Program. The NPDES Permit Program is the primary federal program that regulates point-source and nonpoint-source discharges to waters of the United States.

The State Water Resources Control Board (SWRCB) issues both general and individual permits for certain activities. Relevant general and individual NPDES permits are discussed below.

Construction Activities

Construction activities are regulated under the NPDES General Permit for Discharges of Storm Water Runoff associated with Construction Activity (General Construction Permit), provided that the total amount of ground disturbance during construction exceeds one acre.

The appropriate Regional Water Quality Control Board enforces the General Construction Permit. Coverage under a General Construction Permit requires the preparation of a stormwater pollution prevention plan (SWPPP) and submittal of a notice of intent (NOI). The SWPPP includes pollution prevention measures (erosion and sediment control measures and measures to control non-stormwater

discharges and hazardous spills), demonstration of compliance with all applicable local and regional erosion and sediment control standards, identification of responsible parties, a detailed construction timeline, and a best management practices monitoring and maintenance schedule. The NOI includes site-specific information and the certification of compliance with the terms of the General Construction Permit.

Dewatering Activities

Small amounts of construction-related dewatering are covered under the General Construction Permit. However, the RWQCB may require that an individual NPDES permit and Waste Discharge Requirement (WDR) be obtained for dewatering activities.

Section 404

Section 404 of the CWA regulates the discharge of dredged and fill materials into waters of the United States, which include oceans, bays, rivers, streams, lakes, ponds, and wetlands. Project proponents must obtain a permit from the U.S. Army Corps of Engineers for all discharges of dredged or fill material into waters of the United States, including wetlands, before proceeding with a proposed activity.

Before any actions that may impact surface waters are carried out, a delineation of jurisdictional waters of the United States must be completed following U.S. Army Corps of Engineers protocols (Environmental Laboratory 1987) to determine whether the project area encompasses wetlands or other waters of the United States that qualify for CWA protection. These include any or all of the following:

- areas within the ordinary high water mark of a stream, including nonperennial streams with a defined bed and bank, and any stream channel that conveys natural runoff, even if it has been realigned; or
- seasonal and perennial wetlands, including coastal wetlands.

Wetlands are defined for regulatory purposes as areas “inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (33 CFR 328.3, 40 CFR 230.3).

Under the Section 404 permit program, general permits (known as nationwide permits) have been adopted, and coverage under nationwide permits is possible when the amount of fill is relatively small (usually less than 0.5 acre). Projects that do not qualify for a nationwide permit must obtain an individual permit, which has a longer and more involved permitting process.

Regulations Covering Development on Floodplains

Federal Flood Insurance Program

Alarmed by increasing costs of disaster relief, Congress passed the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The intent of these acts was to reduce the need for large, publicly funded flood control structures and disaster relief by restricting development on floodplains.

FEMA (Federal Emergency Management Agency) administers the National Flood Insurance Program to provide subsidized flood insurance to communities that comply with FEMA regulations limiting development in floodplains. FEMA issues Flood Insurance Rate Maps (FIRM) for communities participating in the National Flood Insurance Program. These maps delineate flood hazard zones in the community. The locations of FEMA-designated floodplains in the proposed project area are included in the discussion of physical setting below.

Porter-Cologne Water Quality Control Act of 1969

The Porter-Cologne Water Quality Control Act established SWRCB and divided the state into nine regional basins, each with a regional water quality control board. SWRCB is the primary state agency responsible for protecting the quality of the state's surface and groundwater supplies, while the regional boards are responsible for developing and enforcing water quality objectives and implementation plans. The project area is within the jurisdiction of the Los Angeles Regional Water Quality Control Board (RWQCB).

The Act authorizes SWRCB to enact state policies regarding water quality in accordance with Section 303 of CWA. In addition, the act authorizes SWRCB to issue WDRs for projects that would discharge to state waters. The Porter-Cologne Water Quality Control Act requires that SWRCB or the regional water quality control board adopt water quality control plans (basin plans) for the protection of water quality. A basin plan must:

- identify beneficial uses of water to be protected;
- establish water quality objectives for the reasonable protection of the beneficial uses; and
- establish a program of implementation for achieving the water quality objectives.

Basin plans also provide the technical basis for determining waste discharge requirements, taking enforcement actions, and evaluating clean water grant proposals. Basin plans are updated and reviewed every three years in accordance with Article 3 of Porter-Cologne Water Quality Control Act and Section 303(c) of CWA. The Los Angeles RWQCB adopted a revised basin plan on June 13, 1994. The basin plan designates beneficial uses and establishes water quality objectives for groundwater and surface water within the Los Angeles region, including the coastal watersheds of Los Angeles and Ventura Counties.

Streambed Alteration Agreement

The CDFG regulates streambed alterations in accordance with Fish and Game Code Sections 1601–1616: Streambed Alterations. Whenever a project proposes to alter a streambed, channel, or bank, an agreement with the CDFG is required.

The agreement is a legally binding document that describes measures agreed to by both parties to reduce risks to fish and wildlife in the stream system during the project. This is a separate process from CEQA approval but is usually coordinated with CEQA compliance. Agreements typically have less procedural and legal requirements than CEQA in order to work with small-scale projects that are important to fish. Time frames for agreements are 30 days for the CDFG to determine the completeness of an application and an additional 60 days to provide a draft agreement to the applicant.

City of Malibu and Coastal Act Policies

The City of Malibu General Plan (City of Malibu 1995) includes goals and policies related to water quality and surface runoff. It should be noted that, as a state agency, DPR is not subject to local plans and policies. However, as the relevant City of Malibu plans, policies, and goals are wholly consistent with the proposed project, they are included in this chapter for the benefit of the reader.

The following goals, policies, and implementation measures from both the Conservation Element and the Land Use Element are relevant to the proposed project.

Conservation Policy 1.3.11 (also Land Use Policy 1.1.3): The City shall control surface runoff and associated pollutant loads into coastal waters, wetlands, and riparian areas.

Land Use Goal 1: The natural and environmental resources of Malibu are protected and enhanced.

Land Use Implementation Measure 4: Regulate grading and excavation to minimize impacts of construction on water quality and natural resources. These regulations shall require the use of best management practices (BMPs) to control erosion and manage stormwater. These BMPs may include the use of seasonal and mandatory year round control measures such as tarps, sandbag dams, onsite retention of first flush rain, temporary drainage courses and erosion control measures, de-silting ponds, sediment traps, filter fencing, straw bales, and catch basin filtration.

Land Use Implementation Measure 6: Evaluate any increase in peak flow rate from surface runoff for proposed development and mitigate any adverse impacts to property or the environment. Require a drainage control system, including onsite retention or detention where appropriate for all new development. Storm runoff control systems shall be designed to ensure that the maximum rate of stormwater runoff does not exceed peak level that existed prior to development.

Land Use Implementation Measure 7: Prohibit grading during the rainy season (from November 1 to March 31) in areas which might affect Resource Protection Areas (RPAs) unless a delay in grading until after the rainy season is determined to be more environmentally damaging. Where grading is permitted during the rainy season, sediment basins (including debris basins, desilting basins, or silt traps) shall be required on the project site prior to or concurrent with the initial grading operations and maintained through the development process.

The project area is located within the California Coastal Zone, as defined by the California Coastal Act. The Coastal Act requires that its goals and policies be implemented by local government through the LCP process. The City of Malibu LCP is discussed in detail in Chapter 4, Consistency with Local and Regional Plans. Water quality goals and policies that are relevant to the proposed project are as follows:

Policy 3.95: New development shall be sited and designed to protect water quality and minimize impacts to coastal waters by incorporating measures designed to ensure the following:

- Protecting areas that provide important water quality benefits, areas necessary to maintain riparian and aquatic biota and/or that are susceptible to erosion and sediment loss.
- Limiting increases of impervious surfaces.
- Limiting land disturbance activities such as clearing and grading, and cut-and-fill to reduce erosion and sediment loss.
- Limiting disturbance of natural drainage features and vegetation.

Policy 3.120: New development shall protect the absorption, purifying, and retentive functions of natural functions that exist on the site. Where feasible, drainage plans shall be designed to complement and utilize existing drainage patterns and systems, conveying drainage from the developed area of the site in a non-erosive manner. Disturbed or degraded natural drainage systems shall be restored, where feasible, except where there are geologic or public safety concerns.

Impacts and Mitigation Measures

Thresholds of Significance

Based on Appendix G of the State CEQA Guidelines and professional judgment, the proposed project would result in a significant impact on hydrology or water quality if it would:

- violate any water quality standards or waste discharge requirements;

- otherwise substantially degrade water quality;
- substantially deplete groundwater supplies or interfere substantially with groundwater recharge, resulting in a net deficit in aquifer volume or a lowering of the local groundwater table level;
- substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on or off site;
- substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate of surface runoff in a manner that causes flooding on or off site, creating or contributing to an existing local or regional flooding problem;
- create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam;
- place within a 100-year flood hazard area structures that would impede or redirect floodflows; or
- contribute to inundation by seiche, tsunami, or mudflow.

Impacts and Mitigation Measures

Construction phase hydrology and water quality impacts (Impacts HYDRO-8 through HYDRO-10) and associated mitigation measures are discussed separately in Chapter 8, Construction Effects.

Impact HYDRO-1: Improved water quality due to increased circulation within the lagoon system.

Lagoon waters do not effectively circulate when the mouth is closed, occurring roughly from May to October each year (Sutula et al. 2004). Low dry season flows entering from upstream are unable to promote any perceptible lagoon circulation because the lagoon is configured with the main body as a broad basin that receives and dissipates any imparted current, by which circulation into the existing western lagoon arms is diminished. Also, vegetative growth within the lagoon reduces potential circulation.

Observations during closed conditions show no effective surface water movement other than minor surface movement across the lagoon from west to east in the afternoon from the prevailing breeze (Moffat & Nichol 2005). Poor circulation contributes to formation of eutrophic conditions in the lagoon, which

in turn degrades water quality and aquatic habitat. Because the lagoon has aggraded with sediment and the water contains high concentrations of nutrients from upstream sources, reduced flow circulation results in increased water temperatures which, when combined with high nutrient concentrations, creates growth of aquatic vegetation that fosters coliform bacteria.

Eutrophic conditions are not aesthetically pleasing, produce undesirable odors, and result in beach closures, all of which negatively affect recreational use of the lagoon. Poor lagoon circulation and resulting reduced water quality conditions thus negatively affect biological and recreational beneficial uses of the lagoon.

As part of the proposed project, a new, deepened channel would be created along the southern edge of the west lagoon and the existing boat channel on the eastern edge of the lagoon would be deepened and recontoured. The new channel in the west lagoon would serve as a single main entrance and exit for water conveyed into and out of the west lagoon. Under open conditions, the proposed project would significantly improve tidal circulation into and out of the western arms, as the feeder channel is sized appropriately to convey tidal discharge constantly throughout its reach.

Storm flow circulation would also be improved under the proposed project because it would allow storm flows into and out of the western arms as needed, without severely high flow velocities to cause damage. Under closed conditions, the new channel in the western portion of the lagoon would allow for increased wind wave generation and probable wind-generated return currents that would result in improved circulation within the system.

Although the restoration plan would improve lagoon geometry and orientation to create more favorable circulation conditions, upstream sources of high nitrogen and phosphorus concentrations would potentially continue to be delivered to the lagoon. As such, control of the sources of such pollutants is beyond the scope of the current restoration project. However, the proposed project would reduce the conditions for eutrophic conditions to develop in the lagoon itself and is therefore considered beneficial.

Consequently, biological and recreational beneficial uses of the lagoon would potentially improve to a level that would meet water quality standards, including the TMDL targets for bacteria. However, due to upstream sources of nitrogen and phosphorus, the proposed project would potentially not improve or contribute to the concentration of nutrients in the lagoon to a level such that the TMDL targets for nitrogen and phosphorus would be met.

Overall, the proposed project would result in beneficial impacts to water quality within the lagoon system. No mitigation is required.

Impact HYDRO-2: Altered surface drainage and associated flood flow patterns from proposed parking lot.

Presently, storm water runoff originates from the impervious surfaces of PCH and the visitor parking area and flows to the lagoon. The existing quantity of impervious surfaces at the project site encompasses 1.73 acres (Moffatt & Nichol 2005).

The proposed parking area would be approximately the same size; thus, a similar quantity of storm runoff would be expected. However, the proposed parking area would be constructed of pervious materials, which would only allow surface runoff during 50-year or larger storm events. Consequently, for the majority of storm events at the site, runoff would be retained and absorbed within the pervious tiles instead of flowing directly to the lagoon.

Additionally, vegetated drainage swales would be installed along the perimeter of the parking lot area. These swales would be designed to capture runoff from the 100-year storm event. All potential runoff would be redirected away from the lagoon.

The proposed parking lot would reduce the potential for localized flooding, improve the quality of surface runoff, and benefit water quality within the lagoon. While the project would thus result in beneficial impacts, the following mitigation measure is required to ensure long-term proper functioning of the various storm water management components.

Mitigation Measure HYDRO-1: Maintenance of stormwater system.

Permeable tiles, drainage swales, pumps, pipelines, and any associated equipment must be maintained on a regular basis to ensure full functioning. Maintenance may include removal of fine sediments from tile gaps for proper infiltration and periodic sediment removal from drainage swales for capacity maintenance. The project manager will ensure that all components of the storm drainage system are maintained to design and manufacturer specifications on a regular basis.

Impact HYDRO-3: Effects of sediment delivery on beach replenishment and nearshore coastal habitat.

No significant changes to beach formation processes or the nearshore coastal environment are anticipated because of changes in sediment discharge.

The planned restoration involves reconfiguring and reorientation of the western lagoon arm. Currently, the mouths of the western arm are situated to receive sediment-laden storm flows, but are mostly sheltered from scouring by tides or stormflows due to their lack of hydraulic connectivity. As such, deposited sediment is not readily scoured and removed.

Under the proposed project, the inlet channel to the western arm would be relocated southward and positioned to reduce the western arm exposure to sedimentation during and following storms. As such, it is anticipated that more storm delivered sediments would be transported directly to the main lagoon, and subsequently be available to the coastal zone for either beach nourishment or subsequent down-coast transport.

In considering potential impacts to the barrier beach, it is useful to recognize that the beach is a depositional feature comprised of sands (ranging in size from finer sands [0.1 mm] to coarser sands [2 mm]) where geomorphic processes selectively sort these beach sands from finer and coarser materials. Typically, the finer silts and muds are either temporarily stored/deposited in the lagoon or carried out to sea. Coarser gravels and boulders may likewise be stored in the main lagoon in bar forms (Schwarz 1999); or under large stormflow conditions may be delivered directly through a large breach in the barrier beach to the coastal zone.

The proposed project is not likely to significantly alter sand related depositional processes and therefore it is not considered to cause a significant impact to the barrier beach. Changes to the proposed inlet of the western arm may concentrate flows and possibly increase local scour and delivery of sands to/from the flood tide and ebb tide deltaic sand lobes associated with the barrier beach.

As the Malibu watershed system is highly variable annually, outcomes of individual storm events are difficult to predict or determine. However, the general form of the estuarine lagoon suggests that even following such large geomorphic events, natural feedback processes occur, which return the lagoon to its general form as a water feature that is transitional between the upstream river and downstream coast. Potential impacts would be less than significant and no mitigation measures are necessary.

Impact HYDRO-4: Effects on tidal lagoon opening and closure.

The sandbar at the mouth of the lagoon typically forms in May or June and may proceed through a series of natural closures and breaches until a sustained closure is endured through the summer and early fall (Moffat & Nichol 2005). The timing and duration of summer closures is dependent upon a number of factors including previous winter rainfall (streamflow magnitude and duration), Malibu Creek water table base flows, longshore sand transport, and tidal and swell dynamics of the Pacific Ocean.

In late fall, once flows in Malibu Creek become high enough to fill the lagoon and overtop the beach berm, flows once again reach the ocean and open the lagoon, quickly scouring a channel through the sand. The exact dates associated with lagoon openings and closures vary due to the variability in annual flow conditions into (and out of) Malibu Creek.

While the proposed project will alter the geometry, volume, and orientation of the lagoon, it will not significantly affect the mass water balance of the watershed that is the principal influence behind the lagoon being either open or closed. The proposed project is not anticipated to alter these seasonal patterns or the processes driving lagoon opening and closure, and hence no significant changes to this process are anticipated. However, once in a closed lagoon situation, the proposed project would provide a larger lagoon geometry to contain summer dry season flows. Thus the project is expected to result in a beneficial impact and no mitigation measures are required.

Impact HYDRO-5: Potential to expose people or structures to risk of flooding or impede 100-yr floodflows.

Presently, there is no significant risk of loss, injury, or death from flood flows in the immediate project area, except when large storm events occur during very high tides. The proposed project would result in reduced flood hazard risk to people and structures surrounding the lagoon through increased lagoon capacity from the reconfigured channels. The storm water system implemented for the realigned parking area would reduce and redirect stormflows in an improved manner compared to existing conditions. Consequently, a beneficial impact would result from the proposed project.

Impact HYDRO-6: Potential to alter groundwater functioning.

The proposed project would involve reconfiguration of surface water runoff and lagoon morphology. The existing groundwater supply, recharge, and groundwater table would be potentially affected at a minor level due to altered circulation and surface drainage. However, a significant change to groundwater would be immeasurable. Consequently, the proposed project would have a less-than-significant impact on groundwater in the project area. No mitigation is necessary.

Impact HYDRO-7: Potential to contribute to inundation by seiche, tsunami, or mudflow.

Based on the project's location and extent, with its focus on the peripheral areas of the lagoon (either on the western arm or eastern boat-house channel), the proposed project would not alter the existing potential for the area to be inundated by coastal processes of seiche or tsunami, or more hillslope related mudflow processes. Consequently, potential impacts would be less than significant. No mitigation is necessary.